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Fertilizer In Relation To Oklahoma Agriculture

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Considerable comment has been made on the original fertility of Oklahoma soils when they were in the virgin state. We have heard of the great expanse of tall grasses and the wonderful growth that occurred before the land was brought under cultivation. These accounts have been used to impress upon us the high fertility level of our virgin soils. In reality not all soils that produced such luxuriant growth in their virgin state were as well supplied with plant nutrients as these accounts would lead one to believe. Not many soil areas in this state are blessed with a large potential supply of nutrients. In fact, few of our soils have such a supply. Many of the soil areas of the state never had a high level of fertility even under virgin conditions. They were fairly productive of native grasses because of the rapid turnover of available plant food; and, since erosion was controlled by the vegetation, the soil continued to produce. A glance at the data in Table I will show what I have just expressed. Figure 1 shows the soil areas listed in the table.

The native grasses are good feeds but they have limited nutrient value. Their content of such nutrients as phosphorus and calcium is not high compared with many cultivated crops;

TABLE I—Fertility Data on Oklahoma Soils, by Areas.¹

Soil Area	Total Nitrogen ²	Total Phosphorus ²	pH Value	Soil Reaction	Percent low Phosphorus ⁴
1. Black waxy soils	4,001	904	7.05	Neutral	28.1
2. Alluvial soils	2,756	864	7.19	Neutral	10.6
3. Eastern prairie	2,712	561	6.00	Slight ³	67.8
4. Central prairie	2,176	489	6.56	Slight ³	40.0
5. Western prairie	2,072	598	7.33	Neutral	3.6
6. Northern Ozarks	1,954	444	5.81	Medium ³	83.3
7. High Plains	1,709	735	7.80	Basic	0.0
8. Interior Coastal plains	1,718	534	6.61	Neutral	59.3
9. Southern Ozarks	1,484	442	6.37	Slight ³	75.0
10. Central cross timbers	1,386	411	7.03	Neutral	54.1
11. Sand hills and sandy land	962	337	7.16	Neutral	24.7
12. Granite soils	965	320	7.04	Neutral	40.0
13. Southern cross timbers	796	231	7.13	Neutral	78.9

¹ Data from Soil Survey—H. J. Harper, Leader.

² Pounds per acre to a depth of 6 $\frac{3}{4}$ inches.

³ Indicates average acidity.

⁴ Percent of the soils in the area which are low to very low in available phosphorus.

hence the removal of these nutrients from the soil under virgin conditions is not as high as when cultivated crops are grown. Cultivated crops remove more nutrients from the soil; and as plant breeders increase the yielding ability of these crops the removal of nutrients becomes greater. Improved cultural practices in producing larger yields are also significant in this respect. These are all legitimate factors, but it is also legitimate and essential that the land operator consider what is taking place in the soil, and place into action some soil maintaining and building practices.

The accompanying charts (Figures 1 and 2) show what is happening to our yields of corn and cotton. Plant breeders and cultural practices are not able to stem the tide. These breeders and practices are holding up the yield as best they can, but it takes more. Data show that since the land in this state was brought under cultivation our soils have lost considerable fertility. About 36 percent of the original nitrogen and organic matter have disappeared. A large acreage has been abandoned from cultivation because of lack of fertility due to cropping and erosion. These acres will need—besides mechanical repair—fertilizers to replenish their producing

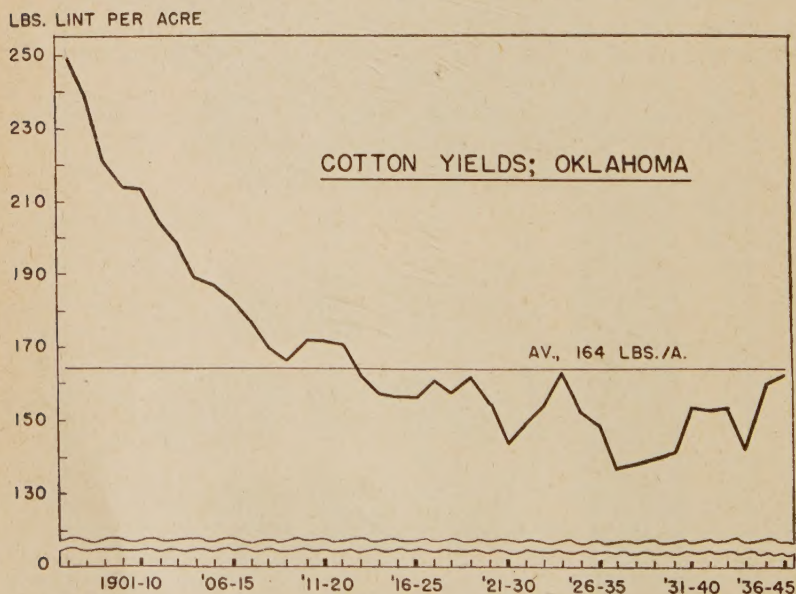


Fig. 2.—Ten-year Average Cotton Yields in Oklahoma, by Years.

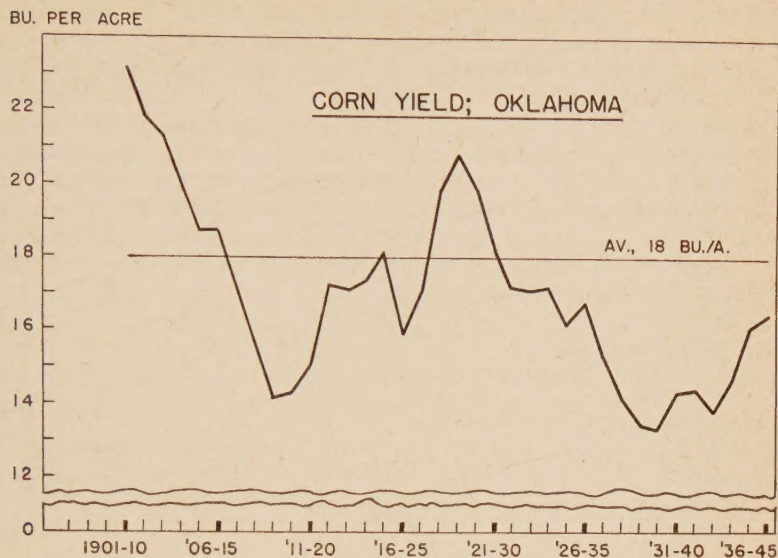


Fig. 3.—Ten-year Average Corn Yields in Oklahoma, by Years.

power. It is not too late to correct these conditions, but it may be too late in some cases for the owner to do it without outside help because of financial reasons. Poverty contributes nothing to the welfare of the soil, except more starvation.

We are carrying out tradition to the Nth degree. We change crops, substituting those with lesser nutrient requirements until all cultivated crops fail and finally the land is "put back to pasture." To grow what? Only a little tickle grass and some other unpalatable plants which contain no nutrients to speak of for the support of animal life, let alone maintenance and growth. These areas must have some fertilizers if they are ever to be a factor in our agriculture and to pay taxes.

A survey of the use of commercial fertilizers in this state shows that the tonnage has been low. The average annual tonnage by five-year periods has been:

1931-35	3,588 tons
1936-40	4,303 tons
1941-45	11,048 tons

To increase crop yields, the yearly fertilizer tonnage should be much higher.

We have done little to help ailing pasture land. Land that has always been in pasture in areas where the rainfall is over 35 inches needs consideration. These pastures could produce a better feed than is at present being produced. Legumes should be introduced, but to grow these legumes fertilizers are often necessary. To get results, a heavy rate of application is necessary. We need to realize, more than we have in the past, the value of a good pasture. The average farm pasture in eastern Oklahoma is not much more than an exercising ground. By fertilization we can increase the yield and nutrient content of species now present, and can greatly increase the pasture value through the introduction of suitable legumes. Legumes will not grow without a good supply of minerals in the soil; therefore the necessity for fertilizers on these soils. Legumes are good feed because they contain lots of nutrients—protein from the nitrogen they collect from the air, and minerals which they secure from the soil. A glimpse at some average analyses will suffice to show why they are good and why we have to fertilize the soil in order to get them to grow:

Average Percentage of:

	Nitrogen	Phosphorus	Potassium	Calcium
Legume hay	1.2 to 2.3	.24	1.69	1.37
Prairie hay	.5 to .6	.08	.5	.28

In considering our needs for nutrients it would be well to consider what we are now removing from our soils each year through cropping, as shown in Table II. *These data do not include other sources of removal such as soil erosion.*

To supply the nutrients removed annually by the crops listed in Table II would require approximately 443,000 tons of ammonium sulfate, 183,000 tons of superphosphate (20% P_2O_5), and 88,000 tons of muriate of potash (50% K_2O). In terms of a high grade commercial fertilizer containing 20 units of plant food per ton, it would require nearly 850,000 tons. Sooner or later we are going to realize this tremendous nutrient removal.

The soils are already giving us the "go sign" for fertilizer application in many areas, as I have already pointed out. The need could be further substantiated by the many tests which the Experiment Station has conducted in various sections of the state. Recently the Station has secured some very interesting and important data on the plowing under of nitrogen fertilizers, and it is safe to project that the use of nitrogen may become quite important on many soils, not only in eastern

**TABLE II—Plant Nutrients Removed from Soil Annually
by Oklahoma Crops.**

(Not including removal by other means, such as erosion.)

Crop	Av. Acres	Nitrogen (lbs.)	Phosphorus (lbs.)	Potassium (lbs.)
Wheat (grain only)	4,026,000	69,448,500	11,876,700	12,883,030
Corn (grain only)	1,903,000	28,107,310	4,776,530	5,347,430
Oats (grain only)	1,360,000	17,408,000	2,896,800	4,216,000
Sorghum (grain only)	760,000	8,519,600	1,170,400	1,406,000
Barley (grain only)	280,000	3,780,000	747,600	915,600
Sorghum (grown only for silage and forage)	1,119,000	28,758,300	3,950,070	36,658,440
Cotton (seed cotton)	2,012,000	16,324,880	6,217,080	7,887,040
Wild hay	418,000	4,915,680	451,440	4,012,800
TOTAL	11,878,000	177,262,270	32,086,620	73,326,510

Oklahoma but in the major wheat area as well. The problem of the return of straw may be a matter of supplying nitrogen in this manner so as to facilitate decomposition and furnish humus for better moisture conditions and physical relationships.

The use of legumes in a soil fertility program as well as a livestock program calls for the use of more mineral fertilizers and lime. It has been estimated that 10,000,000 tons of limestone are needed in the state in order to correct soil acidity sufficiently to grow those legumes having high lime requirements and which are most valuable in adding nitrogen to the soil.* Many of these legumes also require the application of phosphate as well as lime to get the best results. Legumes increase crop yields and furnish a good protein and mineral feed for livestock. Their acreage should be greatly increased; but to accomplish this we will have to use fertilizers. It is pathetic to think that only about 1 acre in 20 now in cultivation is used for growing this important group of crops. Protein feed is at a premium and we should grow more legumes to provide that, if for no other purpose.

Recently I was furnished some important and enlightening data by the State Headquarters of the Selective Service. It is a well known fact that much of the population of this country was not physically fit for war service. Examine and consider the data given in Table III. Note the high percentage of disqualified men, and especially from certain soil areas. Of course there were many contributing factors, but soil fertility is no doubt of great importance. Strong, healthy men cannot be

* Mimeographed report prepared by H. J. Harper (1943).

TABLE III—Percent of Men Physically Disqualified by Selective Service; Oklahoma, by Soil Areas.¹

Soil Area	Percent of Men Disqualified ²
Northern Ozarks	31.0
Southern Ozarks	28.4
Southern Cross Timbers	31.0
Eastern Prairies	21.7
Central Cross Timbers	23.3
Eastern Prairies	23.3
Central Prairies	21.3
High Plains and Western Prairies	19.8

¹ Due to overlapping within counties data could not be isolated for the other soil areas.

² Ages 18 to 25.

grown from products produced on poor soils. The health of the individual is reflected by the fertility of the soil on which his food is grown.

Finally, the soil is not dumb—it speaks a language we can understand if we only will. We need to learn the ABC's of the soil alphabet—and the sign language it expresses. The soil runs together, packs and crusts, stating, "Give me organic matter." It erodes and exclaims, "Tie me down." Water stands on it, and it cries, "Change my underclothes, and give me drainage." It rusts the cotton crop, and speaks for potash. It produces spindly stalks and asks for phosphorus. It slows down growth and yields only some spindly yellow plants, saying, "Oh, that I had some nitrogen."

"My sign language is complete, but how dumb are my listeners," the soil exclaims. "I wish they would do something while they can. I struggle for existence; I want to produce good crops; I want to live and let live but if I don't get help soon, I'll vanish and so will you. You can't get along without me. Give me fertilizers and proper care."